PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-250084
(43)Date of publication of application : 27.09.1996

(51)Int.CI. H01M 2/08
H01M 10/38
H01M 10/40

(21)Application number : 07-112023
(22)Date of filing : 10.05.1995

(71)Applicant : SONY CORP
(72)Inventor : TERAMOTO KAZUNORI

(30)Priority

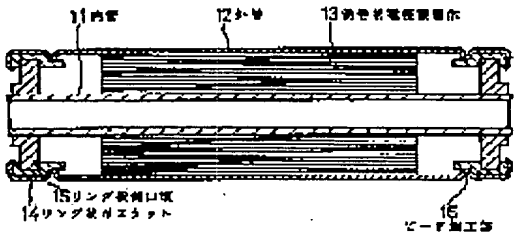
Priority number : 06163240 Priority date : 22.06.1994 Priority country : JP
07 17468 09.01.1995 JP

(54) NONAQUEOUS ELECTROLYTE SECONDARY BATTERY AND MANUFACTURE THEREOF

(57)Abstract:

PURPOSE: To provide a battery excellent in sealing with high productivity by fitting a ring-shaped electric insulating gasket to the internal periphery of an outer tube, and sealing a ring-shaped seal plate press attached between the internal periphery of this gasket and the periphery of an inner tube.

CONSTITUTION: After an electrolyte is injected between an outer tube 12 and an inner tube 11, a ring-shaped electric insulating gasket 14 made of polypropylene or the like and a ring-shaped seal plate 15 made of aluminum or the like are mounted on the internal periphery of the outer tube 12. A side edge of the outer tube 12 is calked, to fix the gasket 14 and the seal plate 15. Threreafter by using a pipe expander, an end part of the inner tube 11 is press attached to the seal plate 15 to be sealed. Accordingly, sealing can be easily performed, without giving damage to a volute electrode laminated unit or the like by a temperature rise, to improve productivity and sealing.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision

of rejection]
[Date of extinction of right]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平8－250084

(43)公開日　平成８年(1996) ９月27日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｈ０１Ｍ　2/08			Ｈ０１Ｍ　2/08	Ｓ	
10/38			10/38		
10/40			10/40	Ｚ	

審査請求　未請求　請求項の数16　ＯＬ　（全 10 頁）

(21)出願番号　特願平7－112023

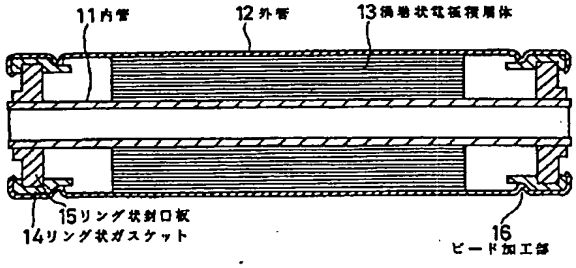
(22)出願日　平成７年(1995) ５月10日

(31)優先権主張番号　特願平6－163240
(32)優先日　平６(1994) ６月22日
(33)優先権主張国　日本（ＪＰ）
(31)優先権主張番号　特願平7－17468
(32)優先日　平７(1995) １月９日
(33)優先権主張国　日本（ＪＰ）

(71)出願人　000002185
ソニー株式会社
東京都品川区北品川６丁目７番35号
(72)発明者　寺本　一憲
東京都渋谷区渋谷２丁目22番３号　株式会社ソニー・エナジー・テック内
(74)代理人　弁理士　松限　秀盛

(54)【発明の名称】　非水電解液二次電池及びその製造方法

(57)【要約】
【目的】　生産性が高く、しかも高い密閉性のある円筒状の非水電解液二次電池を提供することを目的とする。
【構成】　内管１１と外管１２との間に内管１１を芯とし帯状の正極及び負極電極２及び３をセパレータ８を介して渦巻状に巻回してなる渦巻状電極積層体１３を有する二重管型構造であって、この内管１１及び外管１２の夫々の両端部の外管１２の内周に嵌め込まれたリング状電気絶縁ガスケット１４と、このリング状電気絶縁ガスケット１４の内周と、この内管１１の外周との間に設けられる第１及び第２のリング状封口板１５とを有し、この内管１１を、この内側より拡張してこのリング状封口板１５と内管１１とを圧着変形させこの両端部を封口するようにしたものである。



1

【特許請求の範囲】

【請求項１】　外管と、該外管と実質的に同心に配された内管と、

前記外管の一方の端部の内周に嵌め込まれた第１のリング状電気絶縁ガスケットと、

前記第１のリング状電気絶縁ガスケットと前記内管の一方の端部の外周との間を封じる第１のリング状封口板と、

前記内管を芯とし、前記内管の一方及び他方の端部間に非水電解液が含浸された帯状の正極電極及び負極電極がセパレータを介して渦巻状に巻回された渦巻状電極積層体と、前記外管の他方の端部の内周に嵌め込まれた第２のリング状電気絶縁ガスケットと、

前記第２のリング状電気絶縁ガスケットと前記内管の他方の端部の外周との間を封じる第２のリング状封口板とを有することを特徴とする非水電解液二次電池。

【請求項２】　請求項１記載の非水電解液二次電池において、前記内管と前記第１及び第２のリング状封口板とは圧着性を有する金属より成ることを特徴とする非水電解液二次電池。

【請求項３】　請求項２記載の非水電解液二次電池において、

前記渦巻状電極積層体の正極電極及び負極電極の一方を前記内管に接続し、他方を前記外管に接続したことを特徴とする非水電解液二次電池。

【請求項４】　請求項３記載の非水電解液二次電池において、

前記正極電極を前記内管に接続すると共に前記内管をアルミニウムで形成したことを特徴とする非水電解液二次電池。

【請求項５】　請求項１記載の非水電解液二次電池において、

前記第１及び第２のリング状封口板の少なくとも一方のリング状封口板は、内圧が所定圧以上に上昇したときに開裂して内圧を開放する開裂弁を有することを特徴とする非水電解液二次電池。

【請求項６】　請求項５記載の非水電解液二次電池において、

前記開裂弁を有するリング状封口板は、互いに重ねられたときに互いに連通する通気孔を単数又は複数有する第１及び第２のリング状板部材と、該第１及び第２のリング状部材間に挟まれたフィルム部材から成り、該フィルム部材は前記通気孔を塞ぐように前記第１及び第２のリング状部材の間に固着されたことを特徴とする非水電解液二次電池。

【請求項７】　請求項６記載の非水電解液二次電池において、

前記フィルム部材はアルミニウム箔の両面に高分子層を被覆したフィルムであることを特徴とする非水電解液二次電池。

2

【請求項８】　内管の一方の端部及び他方の端部の間に、前記内管を巻芯として帯状の正極電極と負極電極とがセパレータを介して対向するように渦巻状に巻回して渦巻状電極積層体を形成する工程と、

前記内管に渦巻状に巻回された渦巻状電極積層体を外管内に挿入する工程と、

前記外管の一方の端部の内周に第１のリング状電気絶縁ガスケットを嵌め込むと共に前記第１のリング状電気絶縁ガスケットと前記内管の一方の端部の外周との間に第１のリング状封口板を嵌め込み、その後前記内管の一方の端部を内側よりパイプ拡張手段を用いて拡張して前記内管の一方の端部及び前記第１のリング状封口板を圧着し、前記外管の一方の端部と前記内管の一方の端部との間を封口する工程と、

前記外管及び内管の封口された一方の端部を下方にして、上方となる前記内管の他方の端部と前記外管の他方の端部との間に非水電解液を注入する工程と、

前記非水電解液を注入後、前記外管の他方の端部の内周に第２のリング状電気絶縁ガスケットを嵌め込むと共に前記第２のリング状電気絶縁ガスケットと前記内管の他方の端部の外周との間に第２のリング状封口板を嵌め込み、その後前記内管の他方の端部を内側よりパイプ拡張手段を用いて拡張して、前記内管の他方の端部及び前記第２のリング状封口板を圧着し、前記外管の他方の端部と前記内管の他方の端部との間を封口する工程とを有することを特徴とする非水電解液二次電池の製造方法。

【請求項９】　請求項８記載の非水電解液二次電池の製造方法において、

前記非水電解液を注入に先行して、前記第１のリング状封口板を前記第１のリング状電気絶縁ガスケットを介して前記外管をカシメて封口すると共に前記非水電解液を注入後に、前記第２のリング状封口板を前記第２のリング状電気絶縁ガスケットを介して前記外管をカシメて封口することを特徴とする非水電解液二次電池の製造方法。

【請求項１０】　非水電解液二次電池において、軽量金属製の電池容器の開口部のカシメ封口部に金属製補強用部材を填めたことを特徴とする非水電解液二次電池。

【請求項１１】　請求項１０記載の非水電解液二次電池において、前記電池容器は円筒型からなり、前記金属製補強用部材は前記電池容器の両端の開口部をカシメ封口する補強輪からなることを特徴とする非水電解液二次電池。

【請求項１２】　請求項１０記載の非水電解液二次電池において、前記電池容器はアルミニウム製であり、前記金属補強用部材はスチール製あるいはステンレス鋼製であることを特徴とする非水電解液二次電池。

【請求項１３】　電池容器に金属製補強用部材を填めるのに、前記金属製補強用部材の封口加工前に前記電池容器を冷却し、これを室温にある前記金属製補強用部材に

挿入後、放置して圧入することを特徴とする非水電解液二次電池の製造方法。

【請求項１４】　請求項１記載の非水電解液二次電池において、

前記外管が軽金属製であり、前記外管の一方及び他方の端部に金属製補強材が填められていることを特徴とする非水電解液二次電池。

【請求項１５】　請求項１４記載の非水電解液二次電池において、

前記外管はアルミニウム製であり、前記金属製補強部材はスチール製あるいはステンレス鋼製であることを特徴とする非水電解液二次電池。

【請求項１６】　請求項９記載の非水電解液二次電池の製造方法において、前記外管をカシメる工程は前記外管の端部に前記金属補強部材を填めた後に行うようにしたことを特徴とする非水電解液二次電池の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は例えば電気自動車等に使用して好適な高エネルギー密度、大容量が得られる円筒状の非水電解液二次電池に関する。

【０００２】

【従来の技術及び発明が解決しようとする課題】近年、電子技術の進歩により、電子機器の高性能化、小型化、ポータブル化が進み、これら電子機器に使用される二次電池にも高エネルギー密度であることが要求されるようになっている。従来、これら電子機器に使用される二次電池としては、ニッケル・カドミウム電池や鉛電池等が挙げられるが、これら電池は放電電位が低く、エネルギー密度の高い電池を得るという点ではまだ不十分であった。

【０００３】そこで、近年リチウムやリチウム合金もしくは炭素材料のようなリチウムイオンをドープ及び脱ドープ可能な物質を負極電極として用い、また正極電極にリチウムコバルト複合酸化物等のリチウム複合酸化物を使用する非水電解液二次電池であるリチウムイオン二次電池の研究、開発が行われている。

【０００４】このリチウムイオン二次電池は電池電圧が高く、高エネルギー密度を有し、自己放電も少なく且つサイクル特性に優れている。特に省エネルギー、環境汚染等の問題から電力貯蔵用及び電気自動車等で使用する高電圧（数十～数百ボルト）、高エネルギー容量、高エネルギー密度の電池の開発が強く望まれている。

【０００５】このリチウムイオン二次電池の構造として、帯状の正極電極及び負極電極をセパレータを介して巻回してなる渦巻状電極積層体を円筒状の金属ケースに収納した円筒状の非水電解液二次電池が提案されている。この円筒状の非水電解液二次電池は渦巻状電極積層体とすることで電極面積を大きくでき、負荷特性に優れた電池が得られる。

【０００６】一方、斯る高電圧、大容量の渦巻状電極積層体を有する非水電解液二次電池においては、充放電時に発熱することがあるという問題がある。

【０００７】また円筒状の非水電解液二次電池においては、この円筒状の金属ケースの両端部を封口板により封口することが必要であり、この封口板を金属ケースの両端部に取り付けるに、一般にはアルゴン溶接を用いることが考えられるが、このアルゴン溶接時の熱が、この渦巻状電極積層体を破壊する懼れがある。

【０００８】この場合、このアルゴン溶接に代えてレーザー溶接を用いれば、この熱の問題はある程度緩和されるが、このレーザー溶接したときには、この封口板による電池内部の密閉の信頼性が得にくく、また、この密閉性を上げようとするとこの溶接に長い時間がかかって、生産性が著しく悪くなる不都合がある。また超音波溶接も原理的には可能であるが密閉信頼性が低く採用できない。

【０００９】また従来の円筒状の非水電解液二次電池の電池容器は耐蝕性と強度の点から、スチールあるいはステンレス鋼にニッケルメッキしたもの（この場合負極電極と接続される。）が用いられてきた。しかし、これらの材料は比重が大きく、重たいことから重量エネルギー密度的には不利となり、アルミニウムやチタンといった軽金属の容器（この場合正極電極と接続される。）を用いることで電池の軽量化を果たすことが考えられてきた。

【００１０】しかし、この非水電解液二次電池の構成材料としてはチタンは高価な金属で一般民生用途で大量に使用することは難しく、実現的には耐蝕性の点からアルミニウムをこの電池容器として用いるのが一般的である。

【００１１】ところが、このアルミニウムはスチール等に比較して強度的に弱く、軽量化の目的が十分果たせるような薄さの材料を用いて電池容器とした場合、プラスチック製のガスケットを金属間に挟んでカシメ、その応力による電池容器の開口部を封口するような封口部構造では、強度不足により必要なガスケットの圧縮を得ることができない。

【００１２】また、逆にこの封口部で十分なガスケットの圧縮が得られるような厚さの材料を用いて電池容器とした場合には、今度は十分な軽量化の目的が達成できないという不都合があった。

【００１３】本発明の目的は生産性が高く、しかも高い密閉性のある円筒状の非水電解液二次電池を提供することである。

【００１４】更に本発明の目的はこの封口部を確実にし、しかも軽量で保存性と耐久性のある非水電解液二次電池を得ることである。

【００１５】

【課題を解決するための手段】本発明非水電解液二次電

池は内管と外管との間に内管を芯とし帯状の正極及び負極電極をセパレータを介して渦巻状に巻回してなる渦巻状電極積層体を有する二重管型構造であって、この内管及び外管の夫々の両端部の外管の内周に嵌め込まれたリング状電気絶縁ガスケットと、このリング状電気絶縁ガスケットの内周と、この内管の外周との間に設けられる第１及び第２のリンク状封口板とを有し、この内管を、この内側より拡張してこのリング状封口板と内管とを圧着させ、この両端部を封口するようにしたものである。

【００１６】

【作用】本発明によれば内管及び外管の夫々の両端部において、外管の内周にリング状電気絶縁ガスケットを嵌め込み、このリング状電気絶縁ガスケットの内周と内管の外周との間にリング状封口板を圧着して封口するので、例えばバイブエキスパンダーにより簡単にこの封口が行え、温度上昇で渦巻状電極積層体等に損傷を与えることがなく生産性に優れ、しかも、高い密閉性を持ったものを得ることができる。

【００１７】また本発明によれば、内管の内側の孔が通気孔となるので放熱性がそれだけ良くなる。

【００１８】

【実施例】以下図面を参照して本発明非水電解液二次電池の一実施例につき説明しよう。図１において、１３は内管１１を芯として帯状の負極電極３及び正極電極２がセパレータ８を介して互いに対向する如く渦巻状に巻回された渦巻状電極積層体を示す。

【００１９】この内管１１は例えば直径２０ｍｍ、長さ３００ｍｍ、肉厚２ｍｍのアルミニウム製の円筒体より成るものである。

【００２０】この正極電極２としては、平均粒径０．０１５ｍｍの$LiCoO_2$粉末を９１重量部、導電剤としてグラファイト６重量部、結着材としてフッ化ビニリデン樹脂を３重量部を混合し、Ｎ－メチルピロリドンを加えて分散しスラリーとし、これを正極活物質４として図３に示す如く、厚さ０．０３ｍｍの帯状のアルミニウム箔より成る正極集電体５の両面にリード部を残して塗布し、乾燥後圧縮成形して帯状の正極電極２とする。

【００２１】この成形後の帯状の正極電極２としては正極活物質４の塗布厚を両面とも０．０８ｍｍとし、この正極活物質４の塗布部の幅を１９０ｍｍ、長さを３１５０ｍｍとした。

【００２２】また負極電極３としては、出発原料として石油ピッチを用い、これに酸素を含む官能基を１０～２０重量％導入した後、不活性ガス（N_2等）気流中１０００℃で焼成して、炭素材料を得、この炭素材料を粉砕し、平均粒径０．０２ｍｍの炭素材料粉末とし、この炭素材料粉末を９０重量部、結着材としてフッ化ビニリデン樹脂を１０重量部を混合し、これをＮ－メチルピロリドンに分散したスラリーを、負極活物質６として、図３に示す如く、厚さ０．０２ｍｍの帯状の銅箔より成る負極集電体７の両面にリード部を残して塗布し、乾燥後圧縮成形して、帯状の負極電極３とする。

【００２３】この成形後の帯状の負極電極３としては負極活物質６の塗布厚を両面とも０．０８ｍｍとし、この負極活物質６の塗布部の幅を２００ｍｍ、長さを３２００ｍｍとした。

【００２４】このようにして得た帯状の正極電極２の先端部の正極集電体５の正極活物質４の未塗布部であるリード部を上述アルミニウム製の内管１１に超音波溶接等により溶着して巻き付けた後、２枚のセパレータ８として厚さ０．０３８ｍｍ、幅２１０ｍｍ、長さ３３００ｍｍの微多孔性ポリプロピレンフィルムでこの正極電極２を挟み、更に負極電極３をその上に重ねた上で、このアルミニウム製の内管１１に多数回渦巻状に巻き付け、渦巻状電極積層体１３とする。

【００２５】この場合、この渦巻状電極積層体１３の最外周部は長さの関係から負極電極３であり、この部分に負極集電体７の負極活物質６の未塗布部であるリード部が来る如くし、このリード部を厚さ０．０５ｍｍ、幅２００ｍｍ、長さ１６０ｍｍのニッケル箔を抵抗溶接して、この負極集電体７を延長した形にして、この渦巻状電極積層体１３の最外周をこのニッケル箔で包み込む如くする。

【００２６】また、図１において、１２は外管を示し、この外管１２は例えば直径５０ｍｍ、長さ３１０ｍｍ、肉厚０．５ｍｍのスチール管にニッケルメッキを施したもので、図２Ａに示す如く、この外管１２の一端側縁から１５ｍｍのところに深さ５ｍｍのビード加工を加えて、ビード加工部１６を形成し、ここに図２Ａに示す如く、ポリプロピレン製のリング状の電気絶縁ガスケット１４と、アルミニウム製のリング状封口板１５を取り付けた後、図１、図２Ａに示す如くこの外管１２の一端側縁をカシメて、このリング状の電気絶縁ガスケット１４及びリング状封口板１５を固定する。

【００２７】この外管１２に、図１、図２Ｂに示す如く、内管１１を芯として正極電極２及び負極電極３をセパレータ８を介して渦巻状に巻回した渦巻状電極積層体１３を挿入し、この内管１１の一端部をリング状封口板１５の中心孔に挿入し、その縁がリング状封口板１５の外面と丁度合う如くする。この場合、この渦巻状電極積層体１３の外周部のニッケル箔をこの外管１２に接触して電気的に接続する如くし、この渦巻状電極積層体１３の負極電極３のリード部をこの外管１２に接続する。従ってこの場合、内管１１が正極で、外管１２が負極となる。

【００２８】次にバイブエスキバンダー（図示せず）を用いて内管１１の一端部及びリング状封口板１５を圧着し、この外管１２の一端部と内管１１の一端部とをリング状封口板１５を介して封口する如くする。即ち、図２Ｂ及びＣに示す如く、この内管１１の一端部の内側に割

型１７を挿入して、さらにピン１８により押し広げ、この内管１１の一端部の外径を拡大してリング状封口板１５の内周に圧着し、この外管１２及び内管１１の夫々の一端部側をリング状封口板１５を介して封口する。

【００２９】この場合、内管１１の外周のリング状封口板１５の内周への拡大量は例えば０．０５ｍｍであり、このときのこのバイブエキスパンダーによる封口作業の一回に要する時間は約５秒である。

【００３０】その後、図２Ａに示す如く、この外管１２の他端側縁から１５ｍｍのところに深さ５ｍｍのビード加工を加えて、ビード開口部１６を形成する。次に外管１２及び内管１１の封口された一端部を下方にして、上方となる外管１２及び内管１１の他端部の間にプロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中にＬｉＰＦ₆を１モル／リットルの割合で溶解した電解液を注入する。

【００３１】その後、この外管１２の他端部に図２Ａに示す如く、ポリプロピレン製のリング状の電気絶縁ガスケット１４とアルミニウム製のリング状封口板１５とを取り付けた後、図１、図２Ａに示す如く、この外管１２の他端側縁をカシメて、このリング状の電気絶縁ガスケット１４及びリング状封口板１５を固定する。この場合内管１１の他端がリング状封口板１５の中心孔に挿入され、その縁がリング状封口板１５の外面と丁度合う如くする。

【００３２】その後、バイブエキスパンダーを用いて、内管１１の他端部をリング状封口板１５に圧着し、この外管１２の他端部と内管１１の他端部とをリング状封口板１５を介して封口する如くする。即ち、図２Ｂ及びＣに示す如く、この内管１１の他端部の内側に割型１７を挿入して、さらにピン１８により押し広げ、この内管１１の他端部を拡大してリング状封口板１５の内周に圧着し、この外管１２及び内管１１の夫々の他端部側をリング状封口板１５を介して封口する。

【００３３】以上の工程により、直径５０ｍｍ、長さ３００ｍｍ、電気容量２５Ａｈの大容量の二重管型円筒状リチウムイオン二次電池が得られた。

【００３４】本例によれば、内管１１及び外管１２の夫々の両端部において、外管１２の内周にリング状電気絶縁ガスケット１４を嵌め込み、このリング状電気絶縁ガスケット１４の内周と内管１１の外周との間にリング状封口板１５を圧着して封口するので例えばバイブエキスパンダーにより簡単にこの封口が行え、温度上昇がないので渦巻状電極積層体１３等に損傷を与えることがなく生産性に優れ、しかも高い密閉性を持ったものを得ることができる。

【００３５】因みに、比較例として、上述実施例で作成したと同じ帯状の正極電極２、負極電極３、微多孔性ポリプロピレンフィルム８及びニッケル箔を上述実施例同様にアルミニウム製内管１１に、渦巻状に巻き付けて渦巻状電極積層体１３を作製し、これを上述実施例と同様のスチール製の外管１２にビード加工を加えたものに挿入した。

【００３６】ここで、この内管１１を外管１２の一端部のビート加工部１６にポリプロピレン製ガスケット１４を介してカシメにより固定されたアルミニウムのリング状封口板１５の中心孔に挿入し、４００ＷのＹＡＧレーザーを用いて内管１１とこの封口板１５との間をシーム溶接した。この場合、内管１１と封口板１５の中心孔との間隔は０．０１ｍｍであった。この封口に要する時間は約１分であった。

【００３７】次に上述実施例と同様に外管１２の他端部にビード加工を加えた後、この他端部側より上述実施例と同様の電解液を注入した。ここで、この内管１１の他端部を上述同様のアルミニウムのリング状封口板１５の中心孔に挿入すると共にこの封口板１５の外周にガスケット１４を嵌め込み、その後外管１２の他端縁をカシメた後、この内管１１の他端部と封口板１５の内周との間を前述と同様に４００ＷのＹＡＧレーザー用いてシーム溶接し、直径５０ｍｍ、長さ３００ｍｍ、電気容量２５Ａｈの二重管型円筒状リチウムイオン二次電池を得た。

【００３８】上述実施例と比較例とのリチウムイオン二次電池を各々２０個ずつをヘリウムリークテストを行った結果を図４に示す。この図４より実施例のバイブエキスパンダーを用いて圧着により封口したものは、リーク異常は全く見られなかったが、比較例のＹＡＧレーザーによるシーム溶接したものは、約２０％程度のリーク不良が見られる不都合があった。

【００３９】図５は本発明の他の実施例を示す。この図５例は図１例の二重管型円筒状リチウムイオン二重電池の軽量化を図るようにしたものである。この図５例において、図１例に対応する部分には同一符号を付し、その詳細説明は省略する。

【００４０】この、図５例においては図１例のようにして作製した、負極活物質６の塗布部の幅が２００ｍｍ、長さ３２００ｍｍの帯状の負極電極３の先端部の負極集電体７の負極活物質６の未塗布部であるリード部を直径２０ｍｍ、長さ３００ｍｍ、肉厚０．７ｍｍのステンレス製の内管１１ａに抵抗溶接等により溶着して巻き付けた後、２枚のセパレータ８としての厚さ０．０３８ｍｍ、幅２１０ｍｍ、長さ３３００ｍｍの微多孔性ポリプロピレンフィルムで、この負極電極３を挟み、更に正極電極２を重ねた上で、このステンレス製の内管１１ａに多数回渦巻状に巻き付け、渦巻状電極積層体１３ａとする。

【００４１】この場合、この渦巻状電極積層体１３ａの最外周部は正極活物質４の未塗布部の長さ即ちリード部の長さを調節して正極集電体５となる如くし、この最外周部の正極集電体５に厚さ０．０５ｍｍ、幅１９０ｍｍ、長さ１６０ｍｍのアルミニウム箔を超音波溶接して

正極集電体５を延長し形にして、この渦巻状電極積層体１３ａの最外周をこのアルミニウム箔で包み込む如くする。

【００４２】本例においては、直径５０ｍｍ、長さ３１０ｍｍ、肉厚０．３ｍｍのアルミニウム製の比較的軽量の外管１２ａを用意する。

【００４３】ところで非水電解液二次電池の容器材料として使用可能な金属であるアルミニウムとスチールの強度と厚みについて検討すると、スチールの弾性係数はアルミニウムの約３倍ある。そして、一般に曲げ変形のたわみ量は次式（１）で表される。

$$\delta = PL^3 / 4bh^3E \quad (1)$$

δ：たわみ量　　ｂ：板の幅
Ｐ：曲げ外力　　ｈ：板の厚さ
Ｌ：支点間距離　　Ｅ：弾性係数

【００４４】（１）式により厚さh_1のアルミニウム材と厚さh_2のスチール材が同じ外力を受けた時、そのたわみ量が等しくなる条件はＬ，ｂが一定の時、次式（２）で表される。

$$h_1^3E_1 = h_2^3 \cdot E_2 \quad (2)$$

E_1：アルミニウム材の弾性係数
E_2：スチール材の弾性係数

以上により、スチール材を同じ強度を持つアルミニウム材に置き換える場合、スチール材の厚みより１．４倍程度の厚みを持つアルミニウム材を使用する必要があると言える。

【００４５】そこで本例においては外管１２ａを比較的薄いアルミニウムで軽量に構成すると共に封口部にスチール製補強輪を填めることとする。

【００４６】即ち本例においては、図５、図６に示す如くこのアルミニウム製の外管１２ａをマイナス３０℃に冷却した後、その両端の封口部に内径４９．９７ｍｍ、厚さ０．３ｍｍ、長さ３０ｍｍの室温状態のニッケルメッキ鋼製補強輪２０を填めて放置することにより、冷却圧入を行った。

【００４７】この補強輪２０を圧入した外管１２ａの一端側縁から１５ｍｍのところに深さ５ｍｍのビード加工を加えたビード加工部１６を設け、ここに、図５、図６にしめす如くリング状のポリプロピレン製ガスケット１４とリング状のステンレス製の封口板１５ａを取り付けた後、外管１２ａの一端側縁をカシメて、図６に示す如き外管部品を作製した。

【００４８】この外管部品の外管１２ａ内に、上述内管１１ａを芯として巻回された渦巻状電極積層体１３ａをこの内管１１ａの一端側縁と封口板１５ａの外側平面が丁度合うように挿入する。この場合、渦巻状電極積層体１３ａの最外周のアルミニウム箔が外管１２ａの内面に接触して電気的に接続する如くする。従ってこの場合、外管１２ａが正極で、内管１１ａが負極となる。

【００４９】次にバイブエキスパンダー（図示せず）を用いて内管１１ａを広げてリング状封口板１５ａの内周側に密着させ内管１１ａの一端部及び外管１２ａの一端部をリング状封口板１５ａを介して封口する。

【００５０】その後、この外管１２ａの他端側縁から１５ｍｍのところに深さ５ｍｍのビード加工を加えてビート加工部１６を形成する。次に外管１２ａ及び内管１１ａの封口された一端部を下方にしてプロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中にＬｉＰＦ$_6$を１モル／リットルの割合で溶解した電解液を注入する。

【００５１】その後、図５、図６に示す如く、内管１１ａの他端部にリング状のポリプロピレン製の電気絶縁ガスケット１４とステンレス製のリング状封口板１５ａを嵌め込んだ後、この外管１２ａの他端側縁をカシメ、最後に前述と同様にバイブエキスパンダーを用いて、内管１１ａを広げてリング状封口板１５ａの内周に圧着させ図５に示す如き、直径５０ｍｍ、長さ３００ｍｍ、電気容量２５Ａｈ、重量８１２ｇ、重量エネルギー密度１１１Ｗｈ／Ｋｇの二重管型円筒状リチウムイオン二次電池を得た。

【００５２】本例によれば、軽量即ち重量エネルギー密度が良く、封口信頼性の高いリチウムイオン二次電池が得られた。また、この図５例においても図１例同様の作用効果が得られることは容易に理解できよう。

【００５３】因みに、上述図５例を実施例１とし、次に述べる比較例１，２及び３と比較して説明する。比較例１としては、上述実施例１及び図１例と同じ帯状の正極電極２、負極電極３、微多孔性ポリプロピレンフィルム８及びニッケル箔を図１例と同様に外径２０ｍｍ、厚さ１ｍｍ、長さ３００ｍｍのアルミニウム製の内管１１に巻き付けて渦巻状電極積層体１３を作製する。

【００５４】この渦巻状電極積層体１３の最外周部は負極活物質６の未塗布部の長さを調節して負極集電体７とし、この負極集電体７に厚さ０．０５ｍｍ、幅２００ｍｍ、長さ１６０ｍｍのニッケル箔を抵抗溶接し、この負極集電体７を延長した形にして、この渦巻状電極積層体１３の最外周をこのニッケル箔で包み込む如くする。

【００５５】次に、図１に示すと同様に、外径５０ｍｍ、厚さ０．５ｍｍ、長さ３１０ｍｍのスチール製の外管１２の一端部にビード加工を加えてビード加工部１６を設け、ここにリング状のポリプロピレン製のガスケット１４とリング状のアルミニウム製の封口板１５とを取り付けた後、この外管１２の一端側縁をカシメる。この外管１２に、上述の内管１１を芯として巻回した渦巻状電極積層体１３をこの内管１１の端面と封口板１５の外側面とが丁度合うように挿入する。

【００５６】この場合、この渦巻状電極積層体１３の最外周のニッケル箔が外管１２の内周面に接触して電気的に接続したものとする。次にバイブエキスパンダー（図示せず）を用いて内管１１を広げて封口板１５の内周面

と密着させ、外管１２及び内管１１の夫々の一端側をこの封口板１５を介して封口する。

【００５７】その後、この外管１２の他端部側に上述と同様のビード加工部１６を設け、次にプロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中にＬｉＰＦ６を１モル／リットルの割合で溶解した電解液を加える。

【００５８】次に、この内管１１の他端部にリング状のアルミニウム製の封口板１５及びリング状のポリプロピレン製のガスケット１４を嵌め込んだ後、この外管１２の他端側縁をカシメ、その後上述と同様にバイブエキスパンダーを用いて内管１１の他端部を広げて、このリング状封口板１５の内周面に圧着させ、この外管１２及び内管１１の夫々の他端部を封口板１５を介して封口する。

【００５９】以上により、比較例１としての直径５０ｍｍ、長さ３００ｍｍ、電気容量２５Ａｈ、重量８９０ｇ、重量エネルギー密度１０１Ｗｈ／Ｋｇの二重管型円筒状リチウムイオン二次電池を得る。

【００６０】比較例２として、実施例１で作製したものと同じ、帯状の正極電極２、負極電極３、微多孔性ポリプロピレンフィルム及びアルミニウム箔を用い、上述実施例１と同様に外径２０ｍｍ、厚さ０．７ｍｍ、長さ３００ｍｍのステンレス製の内管１１ａを芯として渦巻状に巻回した渦巻状電極積層体１３ａを作製した。

【００６１】この渦巻状電極積層体１３ａの最外周部は正極活物質４の未塗布部の長さを調節して正極集電体５とし、この正極集電体５に厚さ０．０５ｍｍ、幅１９０ｍｍ、長さ１６０ｍｍのアルミニウム箔を超音波溶接して正極集電体５を延長した形にして、この渦巻状電極積層体１３ａの最外周をこのアルミニウム箔で包み込む如くする。

【００６２】次に、図５の実施例１に示すと同様に、外径５０ｍｍ、厚さ０．７５ｍｍ、長さ３１０ｍｍのアルミニウム製の外管１２ａの一端部にビード加工を加えてビード加工部１６を設け、ここにリング状のポリプロピレン製のガスケット１４とリング状のステンレス製の封口板１５とを取り付けた後、この外管１２ａの一端側縁をカシメる。この外管１２ａに上述の内管１１ａを芯として巻回した渦巻状電極積層体１３ａをこの内管１１ａの端面と封口板１５ａの外側面とが丁度合うように挿入する。

【００６３】この場合、この渦巻状電極積層体１３ａの最外周のアルミニウム箔が外管１２ａの内周面に接触する如くして電気的に接続したものとする。次に、バイブエキスパンダー（図示せず）を用いて内管１１ａを広げて封口板１５ａの内周面と密着させ、この外管１２ａ及び内管１１ａの夫々の一端部側をこの封口板１５ａを介して封口する。

【００６４】その後、この外管１２ａの他端部側に、上

述と同様のビート加工部１６を設け、次にプロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中にＬｉＰＦ６を１モル／リットルの割合で溶解した電解液を加える。

【００６５】次にこの内管１１ａの他端部にリング状のステンレス製の封口板１５ａ及びリング状のポリプロピレン製のガスケット１４を嵌め込んだ後、この外管１２ａの他端側縁をカシメ、その後上述と同様にバイブエキスパンダーを用いて内管１１ａの他端部を広げて、このリング状封口板１５ａの内周面に圧着させ、この外管１２ａ及び内管１１ａの夫々の他端部を封口板１５ａを介して封口する。

【００６６】以上により、比較例２としての直径５０ｍｍ、長さ３００ｍｍ、電気容量２５Ａｈ、重量８４８ｇ、重量エネルギー密度１０６Ｗｈ／Ｋｇの二重管型円筒状リチウムイオン二次電池を得る。

【００６７】また比較例３として、実施例１で作製したものと同じ、帯状の正極電極２、負極電極３、微多孔性ポリプロピレンフィルム及びアルミニウム箔を用い、上述実施例１と同様に外径２０ｍｍ、厚さ０．７ｍｍ、長さ３００ｍｍのステンレス製の内管１１ａを芯として渦巻状に巻回した渦巻状電極積層体１３ａを作製した。

【００６８】この渦巻状電極積層体１３ａの最外周部は正極活物質４の未塗布部の長さを調節して正極集電体５とし、この正極集電体５に厚さ０．０５ｍｍ、幅１９０ｍｍ、長さ１６０ｍｍのアルミニウム箔を超音波溶接して正極集電体５を延長した形にして、この渦巻状電極積層体１３ａの最外周をこのアルミニウム箔で包み込む如くする。

【００６９】次に、図５の実施例１に示すと同様に、外径５０ｍｍ、厚さ０．３ｍｍ、長さ３１０ｍｍのアルミニウム製の外管１２ａの一端部にビード加工を加えてビード加工部１６を設け、ここにリング状のポリプロピレン製のガスケット１４とリング状のステンレス製の封口板１５ａとを取り付けた後、この外管１２ａの一端側縁をカシメる。この外管１２ａに上述の内管１１ａを芯として巻回した渦巻状電極積層体１３ａをこの内管１１ａの端面と封口板１５ａの外側面とが丁度合うように挿入する。

【００７０】この場合、この渦巻状電極積層体１３ａの最外周のアルミニウム箔が外管１２ａの内周面に接触する如くして電気的に接続したものとする。次に、バイブエキスパンダー（図示せず）を用いて内管１１ａを広げて封口板１５ａの内周面と密着させ、この外管１２ａ及び内管１１ａの夫々の一端部側をこの封口板１５ａを介して封口する。

【００７１】その後、この外管１２ａの他端部側に、上述と同様のビート加工部１６を設け、次にプロピレンカーボネートとジエチルカーボネートとの等容量混合溶媒中にＬｉＰＦ６を１モル／リットルの割合で溶解した電

解液を加える。

【００７２】次にこの内管１１ａの他端部にリング状のステンレス製の封口板１５ａ及びリング状のポリプロピレン製のガスケット１４を嵌め込んだ後、この外管１２ａの他端側縁をカシメ、その後上述と同様にバイブエキスパンダーを用いて内管１１ａの他端部を広げて、このリング状封口板１５ａの内周面に圧着させ、この外管１２ａ及び内管１１ａの夫々の他端部を封口板１５ａを介して封口する。

【００７３】以上により、比較例３としての直径５０ｍ＊10ｍ、長さ３００ｍｍ、電気容量２５Ａｈ、重量７９０ｇ、重量エネルギー密度１１４Ｗｈ／Ｋｇの二重管型円筒状リチウムイオン二次電池を得る。

【００７４】上述実施例１と比較例１，２及び３との夫々のリチウムイオン二次電池を各５個を６０℃恒温槽に１０日間保存し、保存前後の重量差から電解液の平均蒸発量を測定して封口信頼性の尺度とした。この結果を実施例１と各比較例１～３の仕様差異と共に表１に示す。

【００７５】

【表１】

	実施例１	比較例１	比較例２	比較例３
外管材質	Ａｌ	ステンレス	Ａｌ	Ａｌ
外管厚み(mm)	0.30	0.50	0.75	0.30
内管材質	ステンレス	Ａｌ	ステンレス	ステンレス
内管厚み(mm)	0.70	1.00	0.70	0.70
補強輪	有	無	無	無
電池重量(g)	８１２	８８９	８４８	７９０
重量エネルギー密度(Wh／Kg)	１１１	１０１	１０６	１１４
60℃10日重量減量(g)	0.05	0.04	0.05	１３

【００７６】外管１２がステンレス製の比較例１に対し、このステンレス製の外管１２と同じ強度のアルミニウム厚のアルミニウム製の外管１２ａを用いた比較例２は比較例１に対し、重量エネルギー密度が５％程向上したにすぎないが、封口性は保たれている。

【００７７】実施例１の補強輪２０を用いない比較例３は比較例１に対し重量エネルギー密度は１４％の増加を達成しているが、封口強度が不足であり、実施例１では補強輪２０を設けたので、十分な封口性が保てると共に比較例１に対し、重量エネルギー密度が１０％向上した。

【００７８】また図１及び図５に示す如き、リチウムイオン二次電池においては、一端部及び他端部に設けたリング状封口板１５，１５ａの一方又は双方に内圧が所定圧以上となったときに開裂する開裂弁を設けることを可とする。

【００７９】この開裂弁を有するリング状封口板の例を図７、図８に示す。この開裂弁を有するリング状封口板２１は、図７Ａ及びＣに示す如く、互いに重ねられたときに互いに連通する４つの通気孔２２ａ，２２ｂ，２２ｃ及び２２ｄを有する一方及び他方のアルミニウム製のリング状封口板２１ａ及び２１ｂと、この一方及び他方のリング状封口板２１ａ及び２１ｂの間に挟まれたリング状のフィルム部材２３から成り、このリング状のフィルム部材２３はこの４つの通気孔２２ａ，２２ｂ，２２ｃ，２２ｄを塞ぐようにこの一方及び他方のリング状封口板２１ａ及び２１ｂの間に固着されたものである。

【００８０】このフィルム部材２３としては、図７Ｂに示す如く厚さ０．０２５ｍｍのアルミニウム箔２３ａの両面に厚さ０．０５ｍｍの変性ポリプロピレンをラミネートとしたものを外径４５ｍｍ、内径２１ｍｍのリング状に切り抜いたものであり、本例においてはこのフィルム部材２３を２枚のアルミニウム製のリング状封口板２１ａ及び２１ｂの通気孔２２ａ，２２ｂ，２２ｃ，２２ｄが丁度重なる如くして挟み、２２０℃まで加熱して、このリング状封口板２１ａ及び２１ｂ間に融着し、このフィルム部材２３を開裂弁とする如くする。

【００８１】またこの通気孔２２ａ，２２ｂ，２２ｃ及び２２ｄは図８に示す如く、二つの円が一部重なった形状とし、内圧の上昇によりフィルム部材２３より成る開裂弁が膨らむ変形を起こした時に、この二つの円の重なりによって形成された突部に当たって破れ、この内圧を開放するようにしたものである。

【００８２】この場合、フィルム部材２３より成る開裂弁の開裂する圧力は突部の出っ張り程度に依存するが、上述例では５～１０Ｋｇｆ／ｃｍ² 程度であり、異常高圧にならないうちにこの内圧を開放する機能を十分に果たすことができる。

【００８３】尚、上述実施例においては本発明をリチウムイオン二次電池に適用した例につき述べたが、本発明をその他の非水電解液二次電池に適用できることは勿論である。また上述実施例では内管１１，１１ａをバイブエキスパンダーを用いて広げてリング状封口板１５，１５ａの内周面に圧着したが、必要に応じ、更にこの部分をレーザーシーム溶接を行うようにしても良いことは勿論である。また本発明は上述実施例に限ることなく本発

15

明の要旨を逸脱することなく、その他種々の構成が採り得ることは勿論である。

【００８４】

【発明の効果】本発明によれば内管及び外管の夫々の両端部において、外管の内周にリング状電気絶縁ガスケットを嵌め込み、このリング状電気絶縁ガスケットの内周と内管の外周との間にリング状封口板を圧着して封口するので、例えばパイプエキスパンダーにより簡単にこの封口が行え、温度上昇で渦巻状電極積層体等に損傷を与えることがなく、生産性に優れ、しかも高密閉性を持ったものをえることができる利益がある。

【００８５】また本発明によれば内管の内側の孔が通気孔となるので、放熱性がそれだけ良くなる利益がある。

【図面の簡単な説明】

【図１】本発明非水電解液二次電池の一実施例を示す断面図である。

【図２】本発明非水電解液二次電池の製造方法の例の要部の説明に供する線図である。

【図３】リチウムイオン二次電池の例の説明に供する線＊

16

＊図である。

【図４】本発明の説明に供する線図である。

【図５】本発明の他の実施例を示す断面図である。

【図６】図５例の要部の例を示す断面図である。

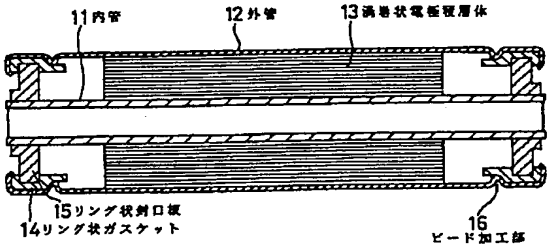
【図７】開裂弁を有するリング状封口板の例の説明に供する線図である。

【図８】図７例のリング状封口板の上面図である。

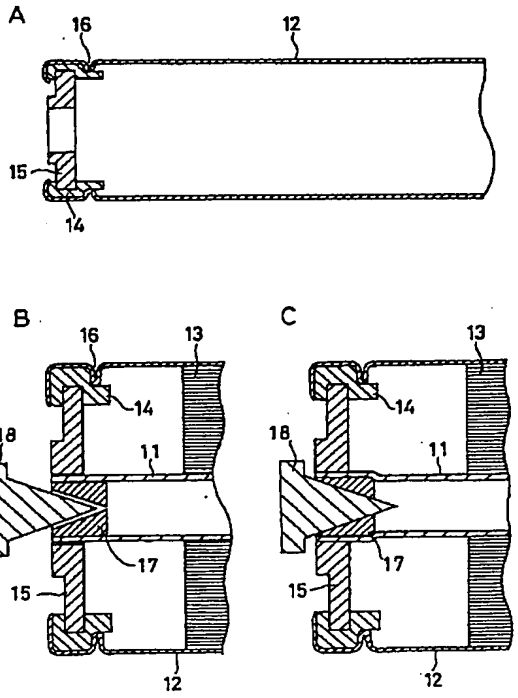
【符号の説明】

１１，１１ａ　内管
１２，１２ａ　外管
１３，１３ａ　渦巻状電極積層体
１４　リング状ガスケット
１５，１５ａ　リング状封口板
１６　ビード加工部
２０　補強輪
２１　開裂弁を有するリング状封口板
２２ａ，２２ｂ，２２ｃ，２２ｄ　通気孔
２３　フィルム部材

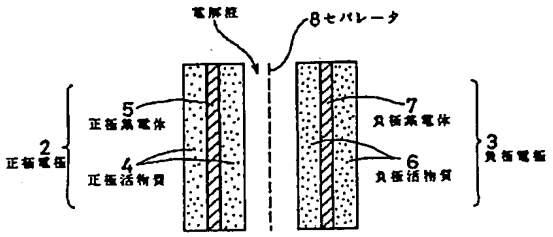
【図１】



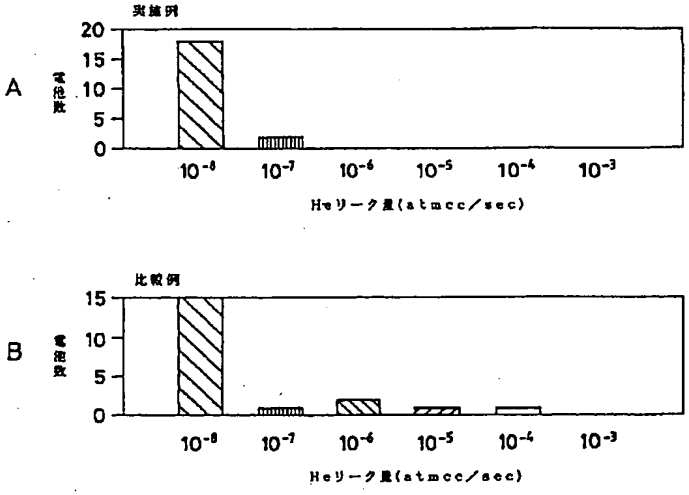
【図２】



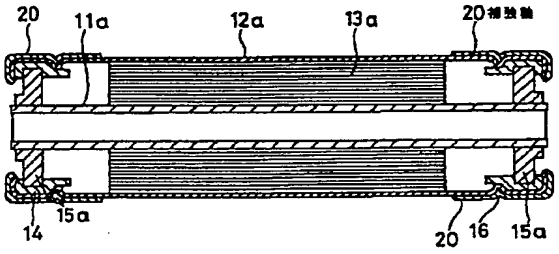
【図３】



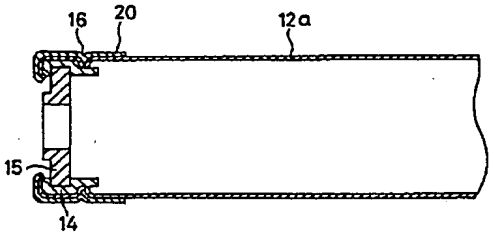
【図４】


実施例
A
20
15
10
5
0
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
Heリーク量(atmcc/sec)
比較例
B
15
10
5
0
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
Heリーク量(atmcc/sec)

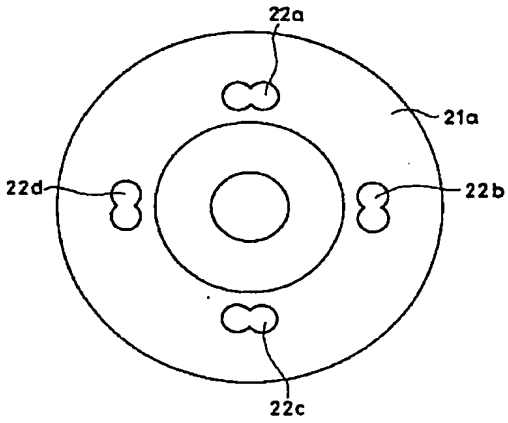
【図５】


20
11a
12a
13a
20
14
15a
20
16
15a

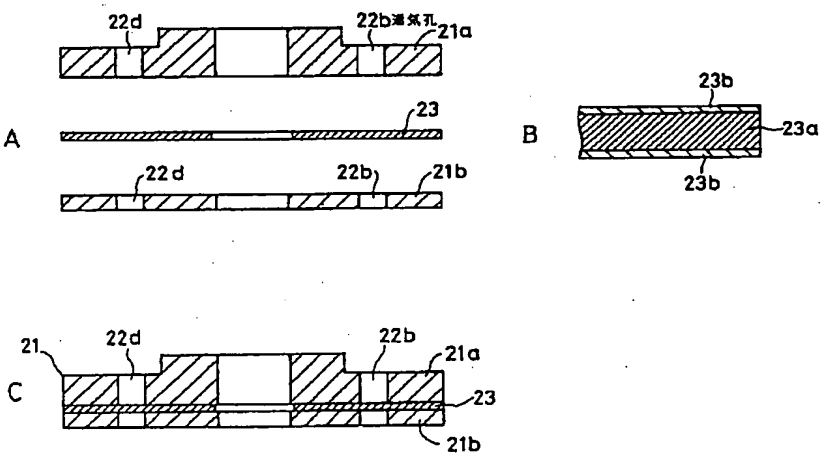
【図６】


16
20
12a
15
14

【図８】


22a
21a
22d
22b
22c

【図７】


22d
22b通気孔
21a
A
23
22d
22b
21b
B
23b
23a
23b
21
22d
22b
21a
C
23
21b

JAPANESE [JP,08-250084,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] An outer tube, the inner tube with which this outer tube was substantially matched for this alignment, and the 1st ring-like electric insulation gasket inserted in the inner circumference of one edge of said outer tube, The 1st ring-like obturation plate which stops between said 1st ring-like electric insulation gasket and peripheries of one edge of said inner tube, The spiral electrode layered product around which the band-like positive-electrode electrode and band-like negative-electrode electrode with which said inner tube was used as the heart, said inner tube reached on the other hand, and nonaqueous electrolyte sank in between the other-end sections were spirally wound through the separator, The nonaqueous electrolyte rechargeable battery characterized by having the 2nd ring-like obturation plate which stops between the 2nd ring-like electric insulation gasket inserted in the inner circumference of the other-end section of said outer tube, said 2nd ring-like electric insulation gasket, and the peripheries of the other-end section of said inner tube.
[Claim 2] It is the nonaqueous electrolyte rechargeable battery characterized by consisting of the metal with which the said inner-tube, said 1st, and 2nd ring-like obturation plates have sticking-by-pressure nature in a nonaqueous electrolyte rechargeable battery according to claim 1.
[Claim 3] The nonaqueous electrolyte rechargeable battery characterized by having connected either the positive-electrode electrode of said spiral electrode layered product, or the negative-electrode electrode to said inner tube, and connecting another side to said outer tube in a nonaqueous electrolyte rechargeable battery according to claim 2.
[Claim 4] The nonaqueous electrolyte rechargeable battery characterized by forming said inner tube with aluminum in a nonaqueous electrolyte rechargeable battery according to claim 3 while connecting said positive-electrode electrode to said inner tube.
[Claim 5] One [at least] ring-like obturation plate of said 1st and 2nd ring-like obturation plates is a nonaqueous electrolyte rechargeable battery characterized by having the cleavage valve which cleaves when internal pressure rises in a nonaqueous electrolyte rechargeable battery according to claim 1 more than place constant pressure, and opens internal pressure.
[Claim 6] In a nonaqueous electrolyte rechargeable battery according to claim 5, the ring-like obturation plate which has said cleavage valve The air hole which is mutually [when it piles up mutually] open for free passage An unit or the 1st which it has, and the 2nd ring-like plate member, this -- the nonaqueous electrolyte rechargeable battery characterized by having consisted of the film member pinched between the 1st and 2nd ring-like members, and this film member fixing between said 1st and 2nd ring-like members so that said air hole may be plugged up.
[Claim 7] It is the nonaqueous electrolyte rechargeable battery characterized by being the film with which said film member covered the macromolecule layer to both sides of aluminium foil in the nonaqueous electrolyte rechargeable battery according to claim 6.
[Claim 8] The process which winds said inner tube spirally so that a band-like positive-electrode electrode and a band-like negative-electrode electrode may counter through a separator as a winding core, and forms a spiral electrode layered product between one edge of an inner tube, and the other-end section, The process which inserts the spiral electrode layered product spirally wound around said inner tube into an outer tube, While inserting the 1st ring-like electric insulation gasket in the inner circumference of one edge of said outer tube, the 1st ring-like obturation plate is inserted in between said 1st ring-like electric insulation gasket and peripheries of one edge of said inner tube. The process which extends one edge of the account inner tube of back to front using a pipe escape means from the inside, sticks one edge of said inner tube, and said 1st ring-like obturation plate by pressure, and obturates between one edge of said outer tube, and one edges of said inner tube, The process which pours in nonaqueous electrolyte between the other-end section of said inner tube with which an edge is caudad carried out

and while it obturated said outer tube and the inner tube turns into the upper part, and the other-end section of said outer tube, After pouring in said nonaqueous electrolyte, while inserting the 2nd ring-like electric insulation gasket in the inner circumference of the other-end section of said outer tube, the 2nd ring-like obturation plate is inserted in between said 2nd ring-like electric insulation gasket and peripheries of the other-end section of said inner tube. The other-end section of the account inner tube of back to front is extended using a pipe escape means from the inside. The manufacture approach of the nonaqueous electrolyte rechargeable battery characterized by having the process which sticks the other-end section of said inner tube, and said 2nd ring-like obturation plate by pressure, and obturates between the other-end section of said outer tube, and the other-end sections of said inner tube.

[Claim 9] The manufacture approach of the nonaqueous electrolyte rechargeable battery characterized by carrying out caulking ****** of said outer tube for said 2nd ring-like obturation plate through said 2nd ring-like electric insulation gasket after pouring in said nonaqueous electrolyte while preceding said nonaqueous electrolyte with impregnation and carrying out caulking ****** of said outer tube for said 1st ring-like obturation plate through said 1st ring-like electric insulation gasket in the manufacture approach of a nonaqueous electrolyte rechargeable battery according to claim 8.

[Claim 10] The nonaqueous electrolyte rechargeable battery characterized by inserting the member for metal reinforcement in the caulking obturation section of opening of a metal lightweight cell container in a nonaqueous electrolyte rechargeable battery.

[Claim 11] It is the nonaqueous electrolyte rechargeable battery characterized by for said cell container consisting of cylindrical and said member for metal reinforcement consisting of a reinforcement ring which carries out caulking obturation of the opening of the both ends of said cell container in a nonaqueous electrolyte rechargeable battery according to claim 10.

[Claim 12] It is the nonaqueous electrolyte rechargeable battery which said cell container is a product made from aluminum, and is characterized by said member for metal reinforcement being a product made from steel, or a product made from stainless steel in a nonaqueous electrolyte rechargeable battery according to claim 10.

[Claim 13] The manufacture approach of the nonaqueous electrolyte rechargeable battery characterized by cooling said cell container before obturation processing of said member for metal reinforcement, and leaving this after inserting in said member for metal reinforcement in a room temperature although the member for metal reinforcement is inserted in a cell container, and pressing it fit in it.

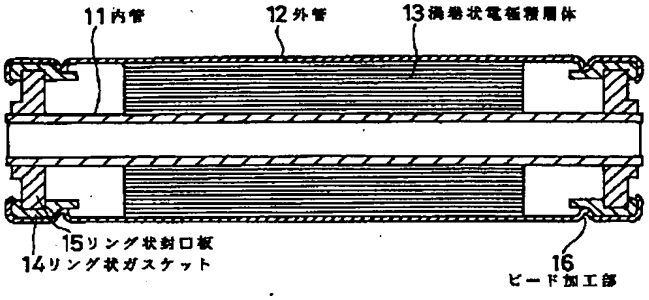
[Claim 14] The nonaqueous electrolyte rechargeable battery which said outer tube is a product made from a light metal, and is characterized by for said outer tube reaching on the other hand, and inserting metal reinforcing materials in the other-end section in a nonaqueous electrolyte rechargeable battery according to claim 1.

[Claim 15] It is the nonaqueous electrolyte rechargeable battery which said outer tube is a product made from aluminum, and is characterized by said metal reinforcement member being a product made from steel, or a product made from stainless steel in a nonaqueous electrolyte rechargeable battery according to claim 14.

[Claim 16] It is the manufacture approach of the nonaqueous electrolyte rechargeable battery characterized by caulking ****** performing said outer tube after inserting said metal reinforcement member in the edge of said outer tube in the manufacture approach of a nonaqueous electrolyte rechargeable battery according to claim 9.

[Translation done.]

Drawing selection Representative drawing



[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the cylinder-like nonaqueous electrolyte rechargeable battery with which it is used for an electric vehicle etc. and a suitable high energy consistency and large capacity are acquired.
[0002]
[Description of the Prior Art] In recent years, the rechargeable battery which high-performance-izing of electronic equipment, a miniaturization, and portable-ization progress, and is used for these electronic equipment by advance of an electronic technique is also required to be a high energy consistency. Conventionally, as a rechargeable battery used for these electronic equipment, although the nickel cadmium battery, the lead cell, etc. were mentioned, these cells had low discharge potential and it was still inadequate [cells] in that a cell with high energy density is obtained.
[0003] Then, research of the rechargeable lithium-ion battery which is a nonaqueous electrolyte rechargeable battery which uses lithium multiple oxides, such as a lithium cobalt multiple oxide, for a positive-electrode electrode, and development are performed in recent years, using a lithium, a lithium alloy, or the matter in which a dope and a dedope of a lithium ion like a carbon material are possible as a negative-electrode electrode.
[0004] This rechargeable lithium-ion battery has high cell voltage, and it has a high energy consistency, and there is also little self-discharge and it excels in the cycle property. Development of the cell of the high voltage (several 10-hundreds of volts) used with the object for stationary energy storage, an electric vehicle, etc., high energy capacity, and a high energy consistency is especially desired strongly from problems, such as energy saving and environmental pollution.
[0005] The nonaqueous electrolyte rechargeable battery of the shape of a cylinder which contained the spiral electrode layered product which comes to wind a band-like positive-electrode electrode and a band-like negative-electrode electrode through a separator as structure of this rechargeable lithium-ion battery to cylinder-like metal casing is proposed. An electrode surface product can be enlarged by making the nonaqueous electrolyte rechargeable battery of the shape of this cylinder into a spiral electrode layered product, and the cell excellent in the load characteristic is obtained.
[0006] On the other hand, in the nonaqueous electrolyte rechargeable battery which has a **** high voltage and a mass spiral electrode layered product, there is a problem that it may generate heat at the time of charge and discharge.
[0007] Moreover, in a cylinder-like nonaqueous electrolyte rechargeable battery, although it is required to obturate the both ends of the metal casing of the shape of this cylinder with an obturation plate and it is possible to use argon gas arc welding generally for attaching this obturation plate in the both ends of metal casing, there is **** to which the heat at the time of this argon gas arc welding destroys this spiral electrode layered product.
[0008] In this case, if it replaces with this argon gas arc welding and laser welding is used, the problem of this heat will be eased to some extent, but when [this] laser welding is carried out, it is hard to acquire the dependability of sealing inside a cell with this obturation plate, and if it is going to raise this sealing nature, this welding will take long time amount, and there is un-arranging [to which productivity gets remarkably bad]. Moreover, although ultrasonic welding is also theoretically possible, sealing dependability cannot adopt low.
[0009] Moreover, what carried out nickel plating of the cell container of the nonaqueous electrolyte rechargeable battery of the shape of a conventional cylinder to steel or stainless steel from the point of corrosion resistance and reinforcement (it connects with a negative-electrode electrode in this case.) has been used. However, it became disadvantageous in weight energy density from these ingredients having large specific gravity and it being heavy,

and it is possible to achieve lightweight-ization of a cell using the container (it connecting with a positive-electrode electrode in this case.) of light metals, such as aluminum and titanium.
[0010] However, as a component of this nonaqueous electrolyte rechargeable battery, titanium is difficult for using it in large quantities with an expensive metal on a general noncommercial use way, and it is common to use aluminum as this cell container from a corrosion-resistant point in implementation.
[0011] However, this aluminum is weak in reinforcement as compared with steel etc., and when it considers as a cell container using the ingredient of the thinness which can achieve the purpose of lightweight-izing enough, with the obturation section structure where opening of caulking and the cell container by that stress is obturate on both sides of the gasket made from plastics between metals, compression of a required gasket cannot be obtain with the lack of on the strength.
[0012] Moreover, when it considered as a cell container using an ingredient of thickness with which compression of gaskets conversely enough in this obturation section is obtained, there was un-arranging [that the purpose of sufficient lightweight-izing could not be attained shortly].
[0013] The purpose of this invention is offering the cylinder-like nonaqueous electrolyte rechargeable battery with which sealing nature's high high moreover has productivity.
[0014] Furthermore, this obturation section is ensured, and moreover, the purpose of this invention is lightweight and is obtaining a nonaqueous electrolyte rechargeable battery with shelf life and endurance.
[0015]
[Means for Solving the Problem] this invention nonaqueous electrolyte rechargeable battery is the double pipe mold structure of having the spiral electrode layered product which uses an inner tube as the heart between an inner tube and an outer tube, and comes to wind a band-like positive electrode and a band-like negative-electrode electrode spirally through a separator. The ring-like electric insulation gasket inserted in the inner circumference of the outer tube of each both ends of this inner tube and an outer tube, Have the 1st and 2nd letter obturation plates of a link formed between the inner circumference of this ring-like electric insulation gasket, and the periphery of this inner tube, and extend this inner tube from this inside, this ring-like obturation plate and inner tube are made to stick by pressure, and these both ends are obturated.
[0016]
[Function] Since according to this invention a ring-like electric insulation gasket is inserted in the inner circumference of an outer tube and a ring-like obturation plate is stuck by pressure and obturated in each both ends of an inner tube and an outer tube between the inner circumference of this ring-like electric insulation gasket, and the periphery of an inner tube, a pipe expander can perform this obturation easily, for example, and damage is not done to a spiral electrode layered product etc. by the temperature rise, it excels in productivity, and what moreover had high sealing nature can be obtained.
[0017] Moreover, according to this invention, since the hole inside an inner tube turns into an air hole, heat dissipation nature becomes so good.
[0018]
[Example] With reference to a drawing, I will explain per example of this invention nonaqueous electrolyte rechargeable battery below. In drawing 1 , 13 shows the spiral electrode layered product spirally wound so that the band-like negative-electrode electrode 3 and the band-like positive-electrode electrode 2 might counter mutually through a separator 8 considering an inner tube 11 as the heart.
[0019] This inner tube 11 consists of the cylinder object with the diameter of 20mm, a die length [of 300mm], and a thickness of 2mm made from aluminum.
[0020] As this positive-electrode electrode 2, it is LiCoO2 with a mean particle diameter of 0.015mm. Powder 91 weight sections, Mix polyvinylidene fluoride resin as an electric conduction agent, and 3 weight sections are mixed as the graphite 6 weight section and binding material. As add N-methyl pyrrolidone, it distributes, it considers as a slurry and it is shown in drawing 3 by making this into positive active material 4, the lead section is left and applied to both sides of the positive-electrode charge collector 5 which consists of band-like aluminium foil with a thickness of 0.03mm, and it presses after desiccation, and considers as the band-like positive-electrode electrode 2.
[0021] As a band-like positive-electrode electrode 2 after this shaping, both sides set coating thickness of positive active material 4 to 0.08mm, width of face of the spreading section of this positive active material 4 was set to 190mm, and die length was set to 3150mm.
[0022] Moreover, after introducing the functional group which contains oxygen in this ten to 20% of the weight as a negative-electrode electrode 3, using a petroleum pitch as a start raw material, it calcinates at 1000 degrees C among an inert gas air current (N2 etc.). Obtain a carbon material, grind this carbon material, and it considers as

carbon material powder with a mean particle diameter of 0.02mm. The slurry which mixed [this carbon material powder] 10 weight sections for polyvinylidene fluoride resin as 90 weight sections and binding material, and distributed this to N-methyl pyrrolidone as a negative-electrode active material 6 As shown in drawing 3 , the lead section is left and applied to both sides of the negative-electrode charge collector 7 which consists of band-like copper foil with a thickness of 0.02mm, and it presses after desiccation, and considers as the band-like negative-electrode electrode 3.

[0023] As a band-like negative-electrode electrode 3 after this shaping, both sides set coating thickness of the negative-electrode active material 6 to 0.08mm, width of face of the spreading section of this negative-electrode active material 6 was set to 200mm, and die length was set to 3200mm.

[0024] Thus, after welding [11] the lead section which is an uncoated portion of the positive active material 4 of the positive-electrode charge collector 5 of the point of the obtained band-like positive-electrode electrode 2 by ultrasonic welding etc. made from the above-mentioned aluminum and twisting it around it, After inserting this positive-electrode electrode 2 as a separator 8 of two sheets with the fine porosity polypropylene film with the thickness of 0.038mm, a width of face [of 210mm], and a die length of 3300mm and piling up the negative-electrode electrode 3 on it further It twists around the inner tube 11 made from this aluminum spirally many times, and considers as the spiral electrode layered product 13.

[0025] In this case, the outermost periphery of this spiral electrode layered product 13 is the negative-electrode electrode 3 from the relation of die length. Carry out as [come / to this part / the lead section which is an uncoated portion of the negative-electrode active material 6 of the negative-electrode charge collector 7], and a nickel foil with the thickness of 0.05mm, a width of face [of 200mm], and a die length of 160mm is welded by resistance for this lead section. It is made the form where this negative-electrode charge collector 7 was extended, and carries out as [wrap / in this nickel foil / the outermost periphery of this spiral electrode layered product 13].

[0026] Moreover, in drawing 1 , 12 shows an outer tube, and this outer tube 12 is what performed nickel plating to steel tubing with the diameter of 50mm, a die length [of 310mm], and a thickness of 0.5mm. As are shown in drawing 2 A, and bead processing with a depth of 5mm is added to the place of 15mm from the end side edge of this outer tube 12, the bead processing section 16 is formed and it is shown here at drawing 2 A, the electric insulation gasket 14 of the shape of a ring made from polypropylene, After attaching the ring-like obturation plate 15 made from aluminum, as shown in drawing 1 and drawing 2 A, the electric insulation gasket 14 of caulking ** and the shape of this ring and the ring-like obturation plate 15 are fixed for the end side edge of this outer tube 12.

[0027] As shown in drawing 1 and drawing 2 B, the spiral electrode layered product 13 which wound spirally the positive-electrode electrode 2 and the negative-electrode electrode 3 through the separator 8 by using an inner tube 11 as the heart is inserted, the end section of this inner tube 11 is inserted in the feed hole of the ring-like obturation plate 15, and it is made this outer tube 12 as [suit / the external surface of the ring-like obturation plate 15 / that edge / exactly]. In this case, it carries out as [connect / contact this outer tube 12 and / the nickel foil of the periphery section of this spiral electrode layered product 13 / electrically], and the lead section of the negative-electrode electrode 3 of this spiral electrode layered product 13 is connected to this outer tube 12. Therefore, an outer tube 12 serves as [an inner tube 11] a negative electrode with a positive electrode in this case.

[0028] Next, the end section of an inner tube 11 and the ring-like obturation plate 15 are stuck by pressure using pipe S KIPANDA (not shown), and it carries out as [obturate / the end section of this outer tube 12, and the end section of an inner tube 11 / through the ring-like obturation plate 15]. That is, as shown in drawing 2 B and C, a split mold 17 is inserted inside the end section of this inner tube 11, and it extends by the pin 18 further, and the outer diameter of the end section of this inner tube 11 is expanded, it is stuck to the inner circumference of the ring-like obturation plate 15 by pressure, and each end section side of this outer tube 12 and an inner tube 11 is obturated through the ring-like obturation plate 15.

[0029] In this case, the amount of expansions to the inner circumference of the ring-like obturation plate 15 of the periphery of an inner tube 11 is 0.05mm, and the time amount which 1 time of the obturation activity by this pipe expander at this time takes is about 5 seconds.

[0030] Then, as shown in drawing 2 A, bead processing with a depth of 5mm is added to the place of 15mm from the other end side edge of this outer tube 12, and the bead opening 16 is formed. Next, it is LiPF6 in the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate between the other end of the outer tube 12 and inner tube 11 which carry out caudad the end section which obturated the outer tube 12 and the inner tube 11, and serve as the upper part. The electrolytic solution which dissolved at a rate of one mol/l. is poured in.

[0031] Then, as shown in the other end of this outer tube 12 at drawing 2 A, after attaching the electric insulation gasket 14 of the shape of a ring made from polypropylene, and the ring-like obturation plate 15 made from

aluminum, as shown in drawing 1 and drawing 2 A, the electric insulation gasket 14 of caulking ** and the shape of this ring and the ring-like obturation plate 15 are fixed for the other end side edge of this outer tube 12. In this case, the other end of an inner tube 11 is inserted in the feed hole of the ring-like obturation plate 15, and it carries out as [suit / the external surface of the ring-like obturation plate 15 / that edge / exactly].

[0032] Then, using a pipe expander, the other end of an inner tube 11 is stuck to the ring-like obturation plate 15 by pressure, and it carries out as [obturate / the other end of this outer tube 12, and the other end of an inner tube 11 / through the ring-like obturation plate 15]. That is, as shown in drawing 2 B and C, a split mold 17 is inserted inside the other end of this inner tube 11, and it extends by the pin 18 further, and the other end of this inner tube 11 is expanded, it is stuck to the inner circumference of the ring-like obturation plate 15 by pressure, and each other end side of this outer tube 12 and an inner tube 11 is obturated through the ring-like obturation plate 15.

[0033] According to the above process, the diameter of 50mm, die length of 300mm, and the mass double pipe mold cylindrical rechargeable lithium-ion battery of electric capacity 25Ah were obtained.

[0034] According to this example, the ring-like electric insulation gasket 14 is inserted in the inner circumference of an outer tube 12 in each both ends of an inner tube 11 and an outer tube 12. Since the ring-like obturation plate 15 is stuck by pressure and obturated between the inner circumference of this ring-like electric insulation gasket 14, and the periphery of an inner tube 11, a pipe expander can perform this obturation easily. Since there is no temperature rise, damage is not done to spiral electrode layered product 13 grade, and it excels in productivity, and what moreover had high sealing nature can be obtained.

[0035] Incidentally the same band-like positive-electrode electrode 2, the negative-electrode electrode 3, the fine porosity polypropylene film 8, and the nickel foil were spirally twisted around the inner tube 11 made from aluminum like the above-mentioned example with having created in the above-mentioned example as an example of a comparison, the spiral electrode layered product 13 was produced, and this was inserted in what added bead processing to the same outer tube 12 made from steel as the above-mentioned example.

[0036] Here, this inner tube 11 was inserted in the feed hole of the ring-like obturation plate 15 of the aluminum fixed to the beat processing section 16 of the end section of an outer tube 12 with caulking through the gasket 14 made from polypropylene, and the seam welding of between an inner tube 11 and this obturation plate 15 was carried out using the YAG laser of 400W. In this case, spacing of an inner tube 11 and the feed hole of the obturation plate 15 was 0.01mm. The time amount which this obturation takes was about 1 minute.

[0037] Next, after adding bead processing to the other end of an outer tube 12 like the above-mentioned example, the electrolytic solution more nearly same than this other end side as the above-mentioned example was poured in. A gasket 14 is inserted in the periphery of this obturation plate 15 while inserting the other end of this inner tube 11 in the feed hole of the ring-like obturation plate 15 of the same aluminum as **** here. 400W carried out the **** seam welding of between the other end of this inner tube 11, and the inner circumference of the obturation plate 15 for the other end edge of an outer tube 12 for YAG lasers like the above-mentioned after caulking ** after that, and the diameter of 50mm, die length of 300mm, and the double pipe mold cylindrical rechargeable lithium-ion battery of electric capacity 25Ah were obtained.

[0038] The result performed [the rechargeable lithium-ion battery of the above-mentioned example and the example of a comparison] the helium leakage test at a time for 20 pieces respectively is shown in drawing 4 . The thing which depends that which obturated by sticking by pressure using the pipe expander of an example from this drawing 4 on the YAG laser of the example of a comparison although the abnormalities in leak were not seen at all and which carried out seam welding having un-arranged [as which about 20% of poor leak is regarded].

[0039] Drawing 5 shows other examples of this invention. This example of drawing 5 attains lightweight-ization of the double pipe mold cylindrical lithium ion duplex cell of the example of drawing 1 . In this example of drawing 5 , the same sign is given to the part corresponding to the example of drawing 1 , and that detail explanation is omitted.

[0040] The width of face of the spreading section of the negative-electrode active material 6 which carried out like the example of drawing 1 , and was produced in this example of drawing 5 200mm, The lead section which is an uncoated portion of the negative-electrode active material 6 of the negative-electrode charge collector 7 of the point of the band-like negative-electrode electrode 3 with a die length of 3200mm The diameter of 20mm, After inner-tube 11 welding by resistance welding etc. made from stainless steel with a die length [of 300mm], and a thickness of 0.7mm and twisting around it, With a fine porosity polypropylene film with the thickness of 0.038mm as a separator 8 of two sheets, a width of face [of 210mm], and a die length of 3300mm After inserting this negative-electrode electrode 3 and piling up the positive-electrode electrode 2 further, it twists around inner-tube 11a made from this stainless steel spirally many times, and is referred to as spiral electrode layered product 13a.

[0041] In this case, the outermost periphery of this spiral electrode layered product 13a is carried out as [become / adjust the die length of the uncoated portion of positive active material 4, i.e., the die length of the lead section, and / the positive-electrode charge collector 5], carries out ultrasonic welding of the aluminium foil with the thickness of 0.05mm, a width of face [of 190mm], and a die length of 160mm to the positive-electrode charge collector 5 of this outermost periphery, extends the positive-electrode charge collector 5, makes it a form, and is carried out as [wrap / in this aluminium foil / the outermost periphery of this spiral electrode layered product 13a].
[0042] In this example, comparatively lightweight outer-tube 12a made from aluminum with the diameter of 50mm, a die length [of 310mm], and a thickness of 0.3mm is prepared.
[0043] By the way, when the aluminum, the reinforcement of steel, and thickness which are a metal usable as a container ingredient of a nonaqueous electrolyte rechargeable battery are examined, there is an elastic modulus of steel a 3 times as many abbreviation of aluminum as this. And generally the amount of deflections of bending deformation is expressed with a degree type (1).
Delta=PL 3 / 4bh3 E (1)
delta: The amount of deflections b: Width-of-face P:bending external force of a plate h: Distance between the thickness L:supporting points of a plate E: Elastic modulus [0044] (1) It is thickness h1 by the formula. Aluminum material and thickness h2 When steel lumber receives the same external force, as for the conditions to which the amount of deflections becomes equal, L and b are expressed with a degree type (2) at the fixed time.
h13E1 =h23, E2 (2)
E1 : Elastic modulus E2 of aluminum material : When transposing steel lumber to aluminum material with the same reinforcement more than with the elastic modulus of steel lumber, it can be said that it is necessary to use the aluminum material which has about 1.4-time thickness from the thickness of steel lumber.
[0045] Then, while constituting outer-tube 12a from comparatively thin aluminum lightweight in this example, suppose that the reinforcement ring made from steel is inserted in the obturation section.
[0046] That is, in this example, as shown in drawing 5 and drawing 6 , after cooling outer-tube 12a made from this aluminum at minus 30 degree C, cooling press fit was performed by inserting in and leaving the nickel-plating steel reinforcement ring 20 of a room temperature condition with 0.3mm [in the bore of 49.97mm and thickness], and a die length of 30mm in the obturation section of those both ends.
[0047] The bead processing section 16 which added bead processing with a depth of 5mm is formed in the place of 15mm from the end side edge of outer-tube 12a which pressed this reinforcement ring 20 fit. After attaching obturation plate 15a of the ring-like gasket 14 made from polypropylene, and the product made from ring-like stainless steel here so that it may be shown in drawing 5 and drawing 6 , the **** outer tube part article which shows the end side edge of outer-tube 12a to caulking ** and drawing 6 was produced.
[0048] Into outer-tube 12a of this outer tube part article, spiral electrode layered product 13a around which above-mentioned inner-tube 11a was wound as the heart is inserted so that the outside flat surface of the end side edge of this inner-tube 11a and obturation plate 15a may suit exactly. In this case, it carries out as [connect / the aluminium foil of the outermost periphery of spiral electrode layered product 13a contacts the inside of outer-tube 12a, and / aluminium foil / electrically]. Therefore, inner-tube 11a becomes [outer-tube 12a] a negative electrode with a positive electrode in this case.
[0049] Next, extend inner-tube 11a using a pipe expander (not shown), it is made to stick to the inner circumference side of ring-like obturation plate 15a, and the end section of inner-tube 11a and the end section of outer-tube 12a are obturated through ring-like obturation plate 15a.
[0050] Then, bead processing with a depth of 5mm is added to the place of 15mm from the other end side edge of this outer-tube 12a, and the beat processing section 16 is formed. Next, the end section which obturated outer-tube 12a and inner-tube 11a is carried out caudad, and it is LiPF6 in the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate. The electrolytic solution which dissolved at a rate of one mol/l. is poured in.
[0051] Then, as shown in drawing 5 and drawing 6 , after inserting ring-like obturation plate 15a of the electric insulation gasket 14 made from ring-like polypropylene, and the product made from stainless steel in the other end of inner-tube 11a, A pipe expander is used for caulking and the last for the other end side edge of this outer-tube 12a like the above-mentioned. The double pipe mold cylindrical rechargeable lithium-ion battery with **** and the diameter of 50mm which extend inner-tube 11a, are made to stick to the inner circumference of ring-like obturation plate 15a by pressure, and are shown in drawing 5 , die length of 300mm, electric capacity 25Ah, a weight [of 812g], and a weight energy density of 111Whs [/kg] was obtained.
[0052] According to this example, the light weight, i.e., a weight energy density, was good, and the rechargeable lithium-ion battery with high obturation dependability was obtained. Moreover, it can be understood easily that the

same operation effectiveness as the example of drawing 1 is acquired also in this example of drawing 5 .
[0053] Incidentally, the example of above-mentioned drawing 5 is made into an example 1, and it explains as compared with the examples 1, 2, and 3 of a comparison described below. As an example 1 of a comparison, the same band-like positive-electrode electrode 2 as the above-mentioned example 1 and the example of drawing 1 , the negative-electrode electrode 3, the fine porosity polypropylene film 8, and a nickel foil are twisted around the inner tube 11 with 1mm [in the outer diameter of 20mm, and thickness], and a die length of 300mm made from aluminum like the example of drawing 1 , and the spiral electrode layered product 13 is produced.
[0054] The outermost periphery of this spiral electrode layered product 13 adjusts the die length of the uncoated portion of the negative-electrode active material 6, uses it as the negative-electrode charge collector 7, welds a nickel foil with the thickness of 0.05mm, a width of face [of 200mm], and a die length of 160mm by resistance to this negative-electrode charge collector 7, makes it the form where this negative-electrode charge collector 7 was extended, and is carried out as [wrap / in this nickel foil / the outermost periphery of this spiral electrode layered product 13].
[0055] Next, it is caulking ** about the end side edge of this outer tube 12 if shown in drawing 1 , after adding bead processing to the end section of the outer tube 12 with 0.5mm [in the outer diameter of 50mm, and thickness], and a die length of 310mm made from steel, forming the bead processing section 16 similarly and attaching the gasket 14 made from ring-like polypropylene, and the obturation plate 15 made from ring-like aluminum here. The spiral electrode layered product 13 which wound the above-mentioned inner tube 11 around this outer tube 12 as the heart is inserted so that the end face of this inner tube 11 and the lateral surface of the obturation plate 15 may suit exactly.
[0056] In this case, the nickel foil of the outermost periphery of this spiral electrode layered product 13 should contact the inner skin of an outer tube 12, and should connect electrically. Next, open an inner tube 11 using a pipe expander (not shown), it is made to stick with the inner skin of the obturation plate 15, and each end side of an outer tube 12 and an inner tube 11 is obturated through this obturation plate 15.
[0057] Then, the same bead processing section 16 as **** is formed in the other end side of this outer tube 12, and then it is LiPF6 in the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate. The electrolytic solution which dissolved at a rate of one mol/l. is added.
[0058] Next, after inserting the obturation plate 15 made from ring-like aluminum, and the gasket 14 made from ring-like polypropylene in the other end of this inner tube 11, extend the other end of an inner tube 11 using a pipe expander like caulking and after that ****, the other end side edge of this outer tube 12 is made to stick to the inner skin of this ring-like obturation plate 15 by pressure, and each other end of this outer tube 12 and an inner tube 11 is obturated through the obturation plate 15.
[0059] By the above, a double pipe mold cylindrical rechargeable lithium-ion battery with the diameter of 50mm as an example 1 of a comparison, die length of 300mm, electric capacity 25Ah, a weight [of 890g], and a weight energy density of 101Whs [/kg] is obtained.
[0060] what was produced in the example 1 as an example 2 of a comparison -- the same -- spiral electrode layered product 13a which wound spirally inner-tube 11a made from stainless steel with 0.7mm [in the outer diameter of 20mm and thickness] and a die length of 300mm as the heart like the above-mentioned example 1 was produced using the positive-electrode electrode 2, the negative-electrode electrode 3, a band-like fine porosity polypropylene film, and band-like aluminium foil.
[0061] The outermost periphery of this spiral electrode layered product 13a is made into the form where adjusted the die length of the uncoated portion of positive active material 4, considered as the positive-electrode charge collector 5, carried out ultrasonic welding of the aluminium foil with the thickness of 0.05mm, a width of face [of 190mm], and a die length of 160mm to this positive-electrode charge collector 5, and the positive-electrode charge collector 5 was extended, and is carried out as [wrap / in this aluminium foil / the outermost periphery of this spiral electrode layered product 13a].
[0062] Next, it is caulking ** about the end side edge of this outer-tube if [shown in the example 1 of drawing 5], and after adding bead processing to the end section with 0.75mm [in the outer diameter of 50mm, and thickness], and a die length of 310mm of outer-tube 12a made from aluminum, forming the bead processing section 16 similarly and attaching gasket [made from ring-like polypropylene] 14, and obturation plate 15 made from ring-like stainless steel here 12a. Spiral electrode layered product 13a which wound above-mentioned inner-tube 11a around this outer-tube 12a as the heart is inserted so that the end face of this inner-tube 11a and the lateral surface of obturation plate 15a may suit exactly.
[0063] In this case, the aluminium foil of the outermost periphery of this spiral electrode layered product 13a

should carry out as [contact / the inner skin of outer-tube 12a], and should connect electrically. Next, extend inner-tube 11a using a pipe expander (not shown), it is made to stick with the inner skin of obturation plate 15a, and each end section side of this outer-tube 12a and inner-tube 11a is obturated through this obturation plate 15a.
[0064] Then, the same beat processing section 16 as **** is formed in the other end side of this outer-tube 12a, and then it is LiPF6 in the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate. The electrolytic solution which dissolved at a rate of one mol/l. is added.
[0065] Next, after inserting the gasket 14 made from the polypropylene of the shape of obturation plate 15a made from ring-like stainless steel, and a ring in the other end of this inner-tube 11a, Extend the other end of inner-tube 11a using a pipe expander like caulking and after that ****, the other end side edge of this outer-tube 12a is made to stick to the inner skin of this ring-like obturation plate 15a by pressure, and each other end of this outer-tube 12a and inner-tube 11a is obturated through obturation plate 15a.
[0066] By the above, a double pipe mold cylindrical rechargeable lithium-ion battery with the diameter of 50mm as an example 2 of a comparison, die length of 300mm, electric capacity 25Ah, a weight [of 848g], and a weight energy density of 106Whs [/kg] is obtained.
[0067] moreover, the thing produced in the example 1 as an example 3 of a comparison -- the same -- spiral electrode layered product 13a which wound spirally inner-tube 11a made from stainless steel with 0.7mm [in the outer diameter of 20mm and thickness] and a die length of 300mm as the heart like the above-mentioned example 1 was produced using the positive-electrode electrode 2, the negative-electrode electrode 3, a band-like fine porosity polypropylene film, and band-like aluminium foil.
[0068] The outermost periphery of this spiral electrode layered product 13a is made into the form where adjusted the die length of the uncoated portion of positive active material 4, considered as the positive-electrode charge collector 5, carried out ultrasonic welding of the aluminium foil with the thickness of 0.05mm, a width of face [of 190mm], and a die length of 160mm to this positive-electrode charge collector 5, and the positive-electrode charge collector 5 was extended, and is carried out as [wrap / in this aluminium foil / the outermost periphery of this spiral electrode layered product 13a].
[0069] Next, it is caulking ** about the end side edge of this outer-tube if [shown in the example 1 of drawing 5], and after adding bead processing to the end section with 0.3mm [in the outer diameter of 50mm, and thickness], and a die length of 310mm of outer-tube 12a made from aluminum, forming the bead processing section 16 similarly and attaching gasket [made from ring-like polypropylene] 14, and obturation plate 15a made from ring-like stainless steel here 12a. Spiral electrode layered product 13a which wound above-mentioned inner-tube 11a around this outer-tube 12a as the heart is inserted so that the end face of this inner-tube 11a and the lateral surface of obturation plate 15a may suit exactly.
[0070] In this case, the aluminium foil of the outermost periphery of this spiral electrode layered product 13a should carry out as [contact / the inner skin of outer-tube 12a], and should connect electrically. Next, extend inner-tube 11a using a pipe expander (not shown), it is made to stick with the inner skin of obturation plate 15a, and each end section side of this outer-tube 12a and inner-tube 11a is obturated through this obturation plate 15a.
[0071] Then, the same beat processing section 16 as **** is formed in the other end side of this outer-tube 12a, and then it is LiPF6 in the amount mixed solvent of isochore of propylene carbonate and diethyl carbonate. The electrolytic solution which dissolved at a rate of one mol/l. is added.
[0072] Next, after inserting the gasket 14 made from the polypropylene of the shape of obturation plate 15a made from ring-like stainless steel, and a ring in the other end of this inner-tube 11a, Extend the other end of inner-tube 11a using a pipe expander like caulking and after that ****, the other end side edge of this outer-tube 12a is made to stick to the inner skin of this ring-like obturation plate 15a by pressure, and each other end of this outer-tube 12a and inner-tube 11a is obturated through obturation plate 15a.
[0073] By the above, a double pipe mold cylindrical rechargeable lithium-ion battery with the diameter of 50mm as an example 3 of a comparison, die length of 300mm, electric capacity 25Ah, a weight [of 790g], and a weight energy density of 114Whs [/kg] is obtained.
[0074] It saved five pieces each for each rechargeable lithium-ion battery of the above-mentioned example 1 and the examples 1, 2, and 3 of a comparison for ten days at 60-degree-C thermostat, the average evaporation of the electrolytic solution was measured from the weight difference before and behind preservation, and it considered as the scale of obturation dependability. This result is shown in Table 1 with the specification difference between an example 1 and each examples 1-3 of a comparison.
[0075]
[Table 1]

	実施例1	比較例1	比較例2	比較例3
外管材質	A1	ステンレス	A1	A1
外管厚み(mm)	0.30	0.50	0.75	0.30
内管材質	ステンレス	A1	ステンレス	ステンレス
内管厚み(mm)	0.70	1.00	0.70	0.70
補強輪	有	無	無	無
電池重量(g)	812	889	848	790
重量エネルギー密度(Wh/Kg)	111	101	106	114
60℃10日重量減量(g)	0.05	0.04	0.05	13

[0076] Obturation nature is maintained although weight energy density of the example [of a comparison] 2 using outer-tube 12a made from the aluminum of the aluminum thickness of the same reinforcement as the outer tube 12 made from this stainless steel improved about 5% to the example 1 of a comparison to the example 1 of a comparison of the product [outer tube / 12] made from stainless steel.
[0077] Although weight energy density had attained 14% of increment to the example 1 of a comparison in the example 3 of a comparison which does not use the reinforcement ring 20 of an example 1, obturation reinforcement was insufficient, and since the reinforcement ring 20 was formed in the example 1, while being able to maintain sufficient obturation nature, weight energy density improved 10% to the example 1 of a comparison.
[0078] Moreover, in **** and the rechargeable lithium-ion battery which are shown in drawing 1 and drawing 5 , it makes it good to prepare the cleavage valve which cleaves when internal pressure turns into more than place constant pressure to one side or the both sides of the ring-like obturation plates 15 and 15a which prepared in the end section and the other end.
[0079] The example of the ring-like obturation plate which has this cleavage valve is shown in drawing 7 and drawing 8 . As the ring-like obturation plate 21 which has this cleavage valve is shown in drawing 7 A and C When it piles up mutually, while it has four air holes 22a, 22b, 22c, and 22d which are mutually open for free passage, and the ring-like obturation plates 21a and 21b made from the aluminum of another side, It consists of the film member 23 of the shape of this ring which reached on the other hand and was inserted among the ring-like obturation plates 21a and 21b of another side. The film member 23 of the shape of this ring fixes among the ring-like obturation plates 21a and 21b of one of these, and another side so that these four air holes 22a, 22b, 22c, and 22d may be plugged up.
[0080]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing one example of this invention nonaqueous electrolyte rechargeable battery.
[Drawing 2] It is the diagram with which explanation of the important section of the example of the manufacture approach of this invention nonaqueous electrolyte rechargeable battery is presented.
[Drawing 3] It is the diagram with which explanation of the example of a rechargeable lithium-ion battery is presented.
[Drawing 4] It is the diagram with which explanation of this invention is presented.
[Drawing 5] It is the sectional view showing other examples of this invention.
[Drawing 6] It is the sectional view showing the example of the important section of the example of drawing 5 .
[Drawing 7] It is the diagram with which explanation of the example of the ring-like obturation plate which has a cleavage valve is presented.
[Drawing 8] It is the plan of the ring-like obturation plate of the example of drawing 7 .
[Description of Notations]
11 11a Inner tube
12 12a Outer tube
13 13a Spiral electrode layered product
14 Ring-like Gasket
15 15a Ring-like obturation plate
16 Bead Processing Section
20 Reinforcement Ring
21 Ring-like Obturation Plate Which Has Cleavage Valve
22a, 22b, 22c, 22d Air hole
23 Film Member

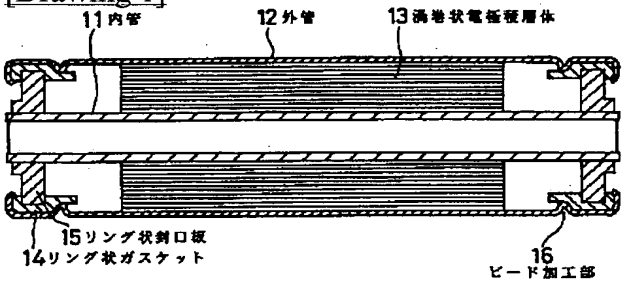
[Translation done.]

* NOTICES *

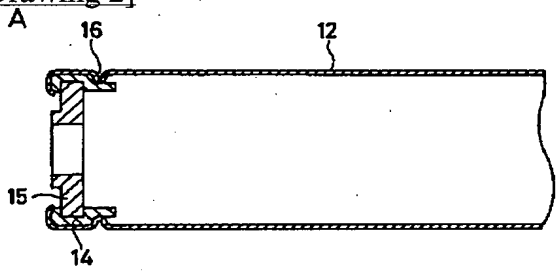
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

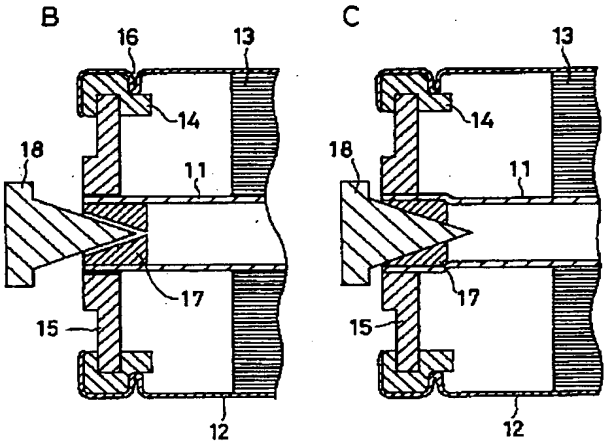
DRAWINGS

[Drawing 1]

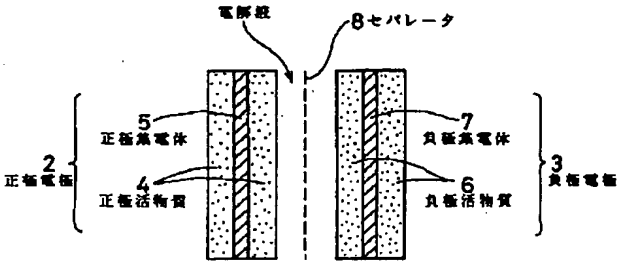


[Drawing 2]

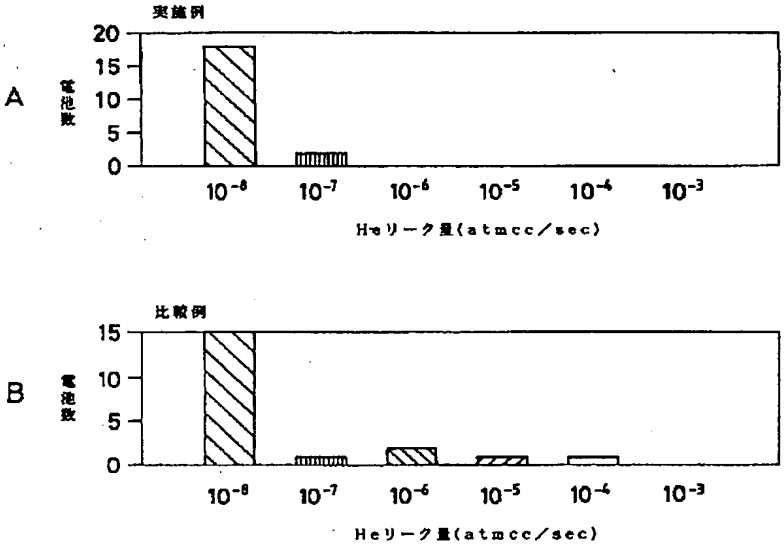




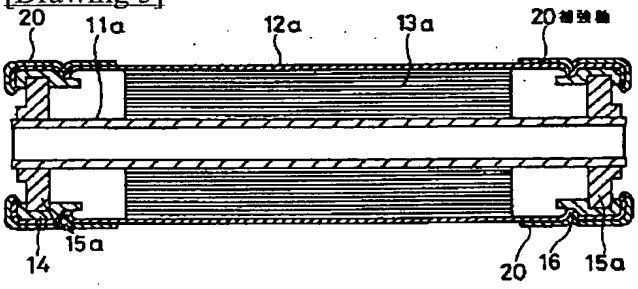
[Drawing 3]



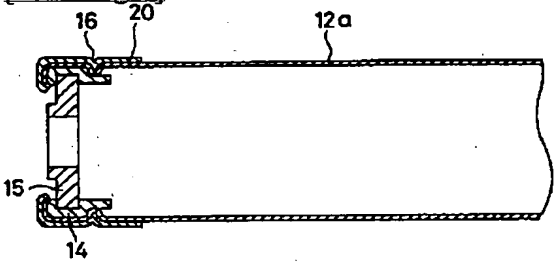
[Drawing 4]



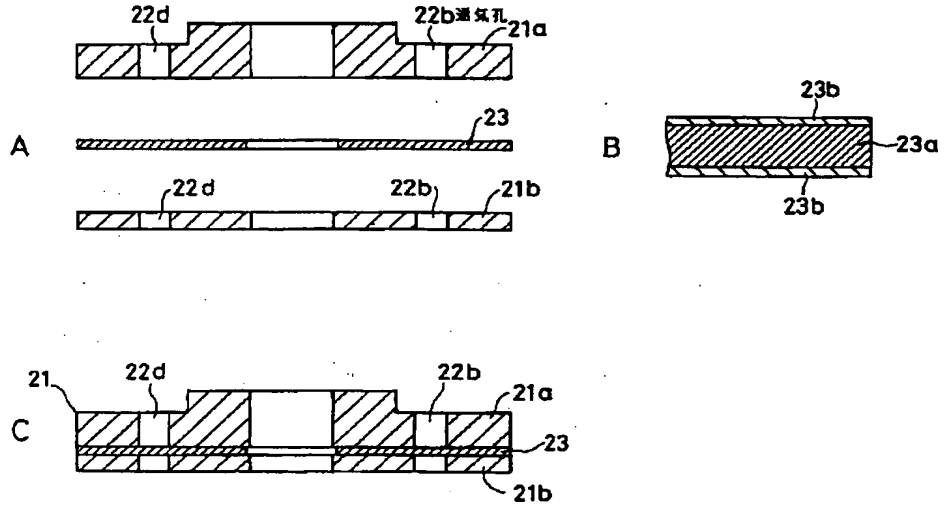
[Drawing 5]



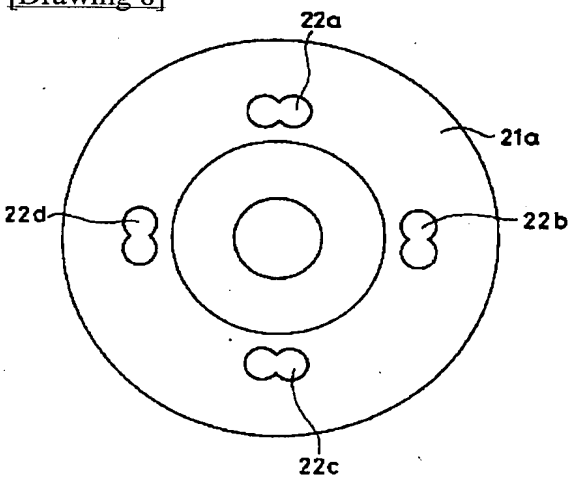
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]